NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

A CASE STUDY OF
INFORMATION RESOURCE MANAGEMENT
IN THE DEPARTMENT OF DEFENSE

by

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March 1992

Principal Advisor: Dan C. Boger

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UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b RESTRICTIVE MARKINGS
2a SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.
2b DECLASSIFICATION/DOWNGRADING SCHEDULE	
4 PERFORMING ORGANIZATION REPORT NUMBER(S)	5 MONITORING ORGANIZATION REPORT NUMBER(S)
6a NAME OF PERFORMING ORGANIZATION Naval Postgraduate School 6b. OFFICE SYMBOL (*If applicable*) 32	7a NAME OF MONITORING ORGANIZATION Naval Postgraduate School
6c ADDRESS (*City, State, and ZIP Code*) Monterey, CA 93943-5000	7b ADDRESS (*City, State, and ZIP Code*) Monterey, CA 93943-5000
8a NAME OF FUNDING/SPONSORING ORGANIZATION 8b OFFICE SYMBOL (*If applicable*)	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c ADDRESS (*City, State, and ZIP Code*)	10 SOURCE OF FUNDING NUMBERS Program Element No / Project No / Task No / Work Unit Accession Number

11 TITLE (*Include Security Classification*)
A Case Study of Information Resource Management in the Department of Defense (UNCLAS)

12 PERSONAL AUTHOR(S) Harkleroad, Joseph, E.

13a TYPE OF REPORT	13b TIME COVERED	14 DATE OF REPORT (*year, month, day*)	15 PAGE COUNT
Master's Thesis	From To	March 1992	89

16 SUPPLEMENTARY NOTATION
The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

17 COSATI CODES			18 SUBJECT TERMS (*continue on reverse if necessary and identify by block number*)
FIELD	GROUP	SUBGROUP	Case study, Corporate Information Management, CIM, Information Resource Management IRM

19 ABSTRACT (*continue on reverse if necessary and identify by block number*)

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20 DISTRIBUTION/AVAILABILITY OF ABSTRACT	21 ABSTRACT SECURITY CLASSIFICATION	
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS REPORT ☐ DTIC USERS	UNCLASSIFIED	
22a NAME OF RESPONSIBLE INDIVIDUAL Professor Dan C. Boger	22b TELEPHONE (*Include Area code*) (408) 646-2607	22c OFFICE SYMBOL AS/Bo

DD FORM 1473, 84 MAR 83 APR edition may be used until exhausted
All other editions are obsolete

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UNCLASSIFIED

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A Case Study of Information Resource Management
in the Department of Defense

by

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Submitted in partial fulfillment
of the requirements for the degree of

MASTER OF SCIENCE IN TELECOMMUNICATIONS SYSTEMS MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
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ABSTRACT

This thesis develops a case study of a Department of Defense (DOD) activity that is suitable for presentation to military information resource management (IRM) students. The case will focus on the applicability of the Corporate Information Management (CIM) model as the framework for an IRM strategy for the Pacific Missile Range Facility (PMRF), Barking Sands, Hawaii.

Presenting a case of organizational control and technical planning to future military managers will provide experience in analyzing problems that are unique to IRM in DOD. Use of this case study will also allow students to acquire skills in developing action plans for a military organization.

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I. INTRODUCTION

A. PURPOSE

The purpose of this thesis is to develop a case study of a Department of Defense (DOD) activity that is suitable for presentation to military information resource management (IRM) students. Studying a case from a military setting will give future information system (IS) managers experience in analyzing problems that are unique to designing systems for DOD applications. Using this case study will also allow the student to acquire skills in developing action plans for a military organization.

A review of Corporate Information Management (CIM) plans will focus on the applicability of the CIM as a framework for the design of an IRM strategy proposal for the Pacific Missile Range Facility (PMRF), at Barking Sands, Hawaii. Developing a strategic communications plan (CommPlan) for the PMRF Communications Branch will provide a more detailed functional vision using CIM process guidelines.

B. SCOPE

This case study is prepared for use in conjunction with the textbook Distributed Intelligence: Trade-Offs and Decisions for Computer Information Systems by William E. Leigh and Clifford Burgess published in 1987. Since the PMRF case

is applicable to DOD IRM, it is meant to be used as a substitute for, or in addition to, the application section of the text, part III.

In place of the decision environment section in Chapter 10 of Leigh and Burgess, CIM should be recognized as the current DOD information system design environment. The background material on CIM in Chapter Three of this thesis is included as a reading assignment on this topic.

The PMRF case is a description of actual events that occurred as described. The characters were based upon the actual participants, yet quotes ascribed to them were edited to ensure that enough information was presented to allow students grasp the complex interactions of the issues. Post cold-war military downsizing, consolidation and the CIM initiative provide the environment for the case. Using the perspective of thesis students as the research team provides the intended audience with a familiar frame of reference.

C. IMPORTANCE OF THE CASE STUDY

Military and corporate leaders must make decisions concerning information system design at strategic, operational and tactical levels. Differences between the products and missions of DOD and the private sector exist that make systems analysis fall short of explaining or diagnosing military activities [Benton p. 4].

Leaders in DOD are faced with risks that have little resemblance to those that affect the private sector. A course of instruction for military managers that only includes IRM case studies from the private sector could leave them ill-prepared to make effective decisions in a military environment.

The justification for the use of information technology (IT) in support of operations has progressed over the years from productivity enhancement (efficiency) issues to strategic issues [Cash p. 9]. This change in the military environment has been highlighted by the advent of DOD Command and Control (C2) systems that provide a force multiplier effect at operational, tactical and strategic levels [Loescher p. 90]. Today's DOD manager needs to acquire skills in the application of this same technology to organizational business operations.

D. BACKGROUND

1. Information As A Resource

As part of the United States Code (USC), the Paperwork Reduction Act of 1980 defined information as a resource and directed that a senior IRM official in each federal agency be designated for its management and control [USC Title 44]. As early as 1965 the Brooks Act had provided a working definition of Automated Data Processing Equipment (ADPE) [USC Title 40 p. 1255], yet no USC definition was provided for IRM until 1986.

2. Information Resource Management Defined

In October 1980, the Third Data Base Directions Workshop was held "... to generate information that managers can apply to evaluate, select, and effectively use information resource management tools." [NBS p. ix] In order to focus on key issues, a working definition of IRM evolved.

> Information Resource Management (IRM) is whatever policy, action, or procedure concerning information (both automated and non-automated) which management establishes to serve the overall current and future needs of the enterprise. Such policies, etc., would include considerations of availability, timeliness, accuracy, integrity, privacy, security, auditability, ownership, use, and cost-effectiveness. [Ibid]

Within the framework of this definition, managers must develop IRM policies that address key IS design issues.

In 1986 Public Law 99-500, the Paperwork Reduction Reauthorization Act, provided this definition:

> The term IRM means the planning, organizing, controlling and management activities associated with the burden, collection, creation, use and dissemination of information by agencies, and ... includes the management of information and resources such as ADPE. IRM involves managing data in such a way that the program and agency managers are able to obtain and use information efficiently, effectively, and economically. [USC Title 44 p. 599]

This definition focuses on efficiency and effectiveness issues which are associated with program (business) management. It also includes the management of ADPE as part of IRM.

3. The Role of Information Resource Management

Information management has become part of enterprise strategic planning [Strassmann-85,90, Cash p. 9, Martin p.

158]. Information is an asset that can be used to develop more efficient and effective information systems [Martin p. 2]. Due to the costs of communication and computing infrastructures, information requirements must be based upon long range (strategic) plans for the organization. Strategic objectives are subject to fewer changes than operational or tactical goals. Synchronizing information systems and long range business planning can result in an IS design that supports organizational strategy.

4. Results of Information Resource Management

In many cases an organization's greatest asset may be its information resource [NBS p. 19]. Managing these resources with increased effectiveness to meet the needs of the organization is the primary objective of IRM [Ibid]. Management at all levels has the unchanging need to ensure "... that the right information is available at the right time to aid in problem solving and decision-making for the enterprise." [NBS p. 20] Adherence to IRM tenets can produce "... a more effective and efficient enterprise information environment." [NBS p. 39]

E. THESIS ORGANIZATION

Motivation and background for the case study method and information system design is contained within Chapter Two. The CIM and DOD Enterprise models are discussed thoroughly in Chapter Three. The first three chapters provide a literature

review for IRM, the case study method of teaching, information systems analysis and design, military modeling theory and the CIM initiative.

Chapters One through Three also serve as a way of describing the current IRM climate in which today's DOD manager must make IS design decisions. Understanding this environment is essential to using this case study to meet educational objectives.

Case research findings and analysis comprise the second logical section of the thesis. Chapter Four provides the organizational background that provides the setting for the case. Chapter Five contains the actual case study of strategic communications planning issues at PMRF.

The case discussion in Chapter Six is intended to provide a basis for the instructor who uses the case in the classroom to focus discussion on the issues that are most pertinent to specific characters. The analysis of the distribution issues that are central to the communications plan is included in this chapter.

Chapter Seven contains the proposed strategic communications plan resulting from the application of information system design techniques to the issues, using CIM as the framework. Chapter Eight presents motivation for conclusions that are implied within the proposed plan.

II. THE CASE METHOD OF TEACHING

No single variety of the case method can be held up as the definitive example of this pedagogy [Glover pp. 13-24, Dooley p. 277]. As used at the Harvard Business School since the 1950's "... a case typically is a record of a business issue which actually has been faced by business executives, together with surrounding facts, opinions, and prejudices upon which executive decisions had to depend." [Gragg p. 6] The case presentation in this thesis will use this definition as a framework for all data collection. Data sources will be used as they relate to the PMRF CommPlan.

A. MOTIVATION AND BENEFITS

Fulfilling educational objectives for military IRM students is the focus of this research. This method of research was chosen to achieve the objectives of developing student skills in analysis of business problems and formulating action plans. These objectives are excellent applications of a case-based method [Dooley. p. 286].

Purpose of thought and opening channels of communication are two ways that this art of instruction can involve students in the process of learning [Gragg pp. 6-7]. The case method also benefits instructors by keeping them in touch with current business practices [Gragg p. 14]. Using the CIM model

as the basis for the case analysis will allow both students and instructors a chance to acquire skills in using the latest DOD IRM model to plan IT systems that are effective and efficient.

B. CASE PREPARATION

Presenting the case study as a way of satisfying education requirements will be the underlying principle of preparation, not merely illustrating "principles," "rules," or points concerning the planning functions of military organizations. This is one of the underlying assumptions of the case method [Ulrich p. 25]. How the manager applies knowledge to the decision-making process will be emphasized to motivate students to acquire and expand their knowledge of IRM. Other basic case preparation pointers from Ulrich will be adapted for this thesis [Ulrich pp. 25-34].

C. DESIGN OF THE PROPOSED PLAN

The planning environment can be described as a dynamic, goal-oriented system. Use of the systems approach to the analysis of such a system can unify scientific knowledge with utility [Laszlo p. 11]. As part of the PMRF case preparation, a partial strategic IRM plan for PMRF will be proposed to serve as the model for the CommPlan.

Two approaches to planning can be pursued in general; they are improvement and design [Van Gigch p. 31]. These paradigms

differ greatly in form and substance and are compared in Table 1.

TABLE 1: SYSTEM IMPROVEMENT AND SYSTEM DESIGN
[Van Gigch Table 2.1, p. 39]

ISSUES	SYSTEM IMPROVEMENT	SYSTEM DESIGN
System Condition	Design set	Design questioned
Concerns	Substance Content Causes	Structure, purpose, method, functions
Paradigm	System and subsystem analysis	Whole system design
Thought processes	Deduction and reduction	Induction and synthesis
Output	Improvement	Optimization
Method	Determine direct costs of actual versus intended	Determine opportunity costs of actual versus optimal
Emphasis	Explain deviations	Predict future
Outlook	Introspective	Extrospective
Planner's role	Follower: satisfies trends	Leader: influences trends

1. System Improvement

This approach assumes that the plan and measures of effectiveness (MOEs) are in place. "Improvement means the transformation or change that brings a system closer to standard or to normal operating condition." [Ibid] Problems are considered within the context of the existing plan, and the manager assumes that the malfunction is created within the bounded system.

Another limitation of system improvement is that the MOEs are considered set and not analyzed as part of the malfunction. This could lead to improvements that are measured against obsolete or detrimental standards. The planner is placed in a position of following trends. Using system improvement methods, the "planner-follower" develops plans that satisfy trends. [Van Gigch p. 36]

2. System Design

Innovative solutions characterize the creative design process [Van Gigch p. 31]. Standards, goals and MOEs are all in question during the planning analysis. Considering outside influences and factors can be the key element in an effective solution.

A proactive plan can result in a more orderly solution since the impact of the design has been anticipated [Van Gigch p. 36]. The "planner-leader" using system design techniques can influence future trends.

D. LEVELS OF INQUIRY

Proposed plans can take on various forms based upon the level of investigation [Van Gigch p. 17]. Categorizing the level of the problem can assist the manager in determining an appropriate approach and form for the recommendations. Three general levels are recognized in systems theory that have corresponding meanings in the corporate and military environments. Table 2 illustrates these relationships.

TABLE 2: LEVELS OF ABSTRACTION [Van Gigch pp. 17 - 19]

SYSTEMS THEORY	CORPORATE	MILITARY
Metamodeling	Strategic	Strategic
Modeling	Tactical	Operational
Implementation	Operational	Tactical

A strategic level design proposal will be used for the PMRF IRM plan. This plan will serve as the model for the portions of the operational level plan that are specific to the communications functional area. The CommPlan serves as strategic guidance for operational and tactical plans for future Communication Branch operations.

III. CORPORATE INFORMATION MANAGEMENT MODEL

A. CIM MODEL OVERVIEW AND DEFINITION

In September 1991, the Executive Level Group (ELG) for Defense Corporate Information Management developed "A Plan for Corporate Information Management for the Department of Defense" that has become the IRM strategy for DOD [ELG]. A model of CIM is contained in the preface to that document. Understanding the CIM model is essential to the design of IRM plans for military organizations.

To help understand and use the CIM model correctly, a characterization of the CIM model within military modeling theory is included. Uses of the model will also be described.

The following definition of a model is from Military Modeling, published by the Military Operations Research Society (MORS) in 1984:

> A model is a simplified representation of the entity it imitates or simulates. [MORS p. 1]

A model is further defined as "... an abstraction to assist in making decisions." [MORS p. 3]

1. Model Application

Command, control, communications and intelligence (C^3I) models are a prominent category of models that are also known as information warfare models [MORS, p. 5]. Merging management rules and oversight for IRM and command and control

will require much effort because "... the line between command and control and IRM is fuzzy." [Ludwig p. 80] Since command, control and embedded weapons systems are excluded in the CIM model the initial scope was limited to business oriented IRM applications within the DOD [ELG p. 2]. Reassessment of the inclusion of command and control in CIM programs was considered in the CIM plan [Ibid].

In May 1991, oversight of administrative and C^3I systems was placed under one office making integrated policy possible [Endoso]. A new systems doctrine that derives all information strategies from war requirements must become the focus for IRM [Ibid]. Operation Desert Storm "... shattered the notion that DOD should maintain a barrier between administrative ADP and military systems." [Green]

Copernicus, the United States Navy's post cold war Command, Control, Communications, Computers and Intelligence (C^4I) architecture, leads the CIM effort in the Navy [Brewin-91 p. 14]. Development of Copernicus using CIM principles demonstrates that the CIM model has an application in the information warfare modeling area.

2. Model Type

The CIM plan "... is intended to be a living plan ..." [ELG Forward]. This attribute characterizes the model contained within the plan as a standing model [MORS p. 5].

3. Model Level and Scope

Due to the departmental origins of the CIM model, the level of inquiry for application is the strategic level. This attribute also characterizes the scope of the plan as DOD-wide [Ibid].

4. Model Use

Models that describe the essential processes of the entities they represent are known as descriptive models [Ibid]. The CIM model will be used to describe the DOD IRM environment in which information system design decisions must be made.

5. Goals

Motivation for the CIM model can be more clearly understood by first examining the four goals of the CIM plan:

> 1. Process models that document new and existing business systems by FYxx.
>
> 2. Standard data definitions available for the Department's business and mission areas by FYxx.
>
> 3. A set of common information systems for each function, built upon standard data and business methods, implemented by FYxx.
>
> 4. An open systems computing and communications infrastructure, transparent to the information systems that stand upon it, implemented by FYxx. [ELG p. 21]

To be used successfully, the CIM model must have specific actions that will achieve these goals.

Three resource areas were initially defined that will require action before the visions of the plan can be achieved:

1. Financial

2. Human

3. Material [Ibid]

The DOD implementation plan later expanded these areas. A review of the DOD Enterprise Model follows the CIM discussion.

B. ELEMENTS OF THE MODEL

The Preface of the CIM plan contains the CIM model and an explanation of the elements of the model and their relationships. Figure 1 is a graphical representation of relationship of the CIM elements.

1. Policy

The framework for business methods and performance measures are policies which "... represent a choice among alternatives." [ELG Preface] "Policies are the guiding principles and operating fundamentals that determine the direction an organization shall take." [Ibid] People, values, visions and beliefs are parts of an organizational culture that supplement the policies.

2. Business Methods

As the formal ways of conducting business, business method examination and definition must be pursued continuously "... in order to effect improved operations." [Ibid] This continuing improvement aspect reflects the standing nature of

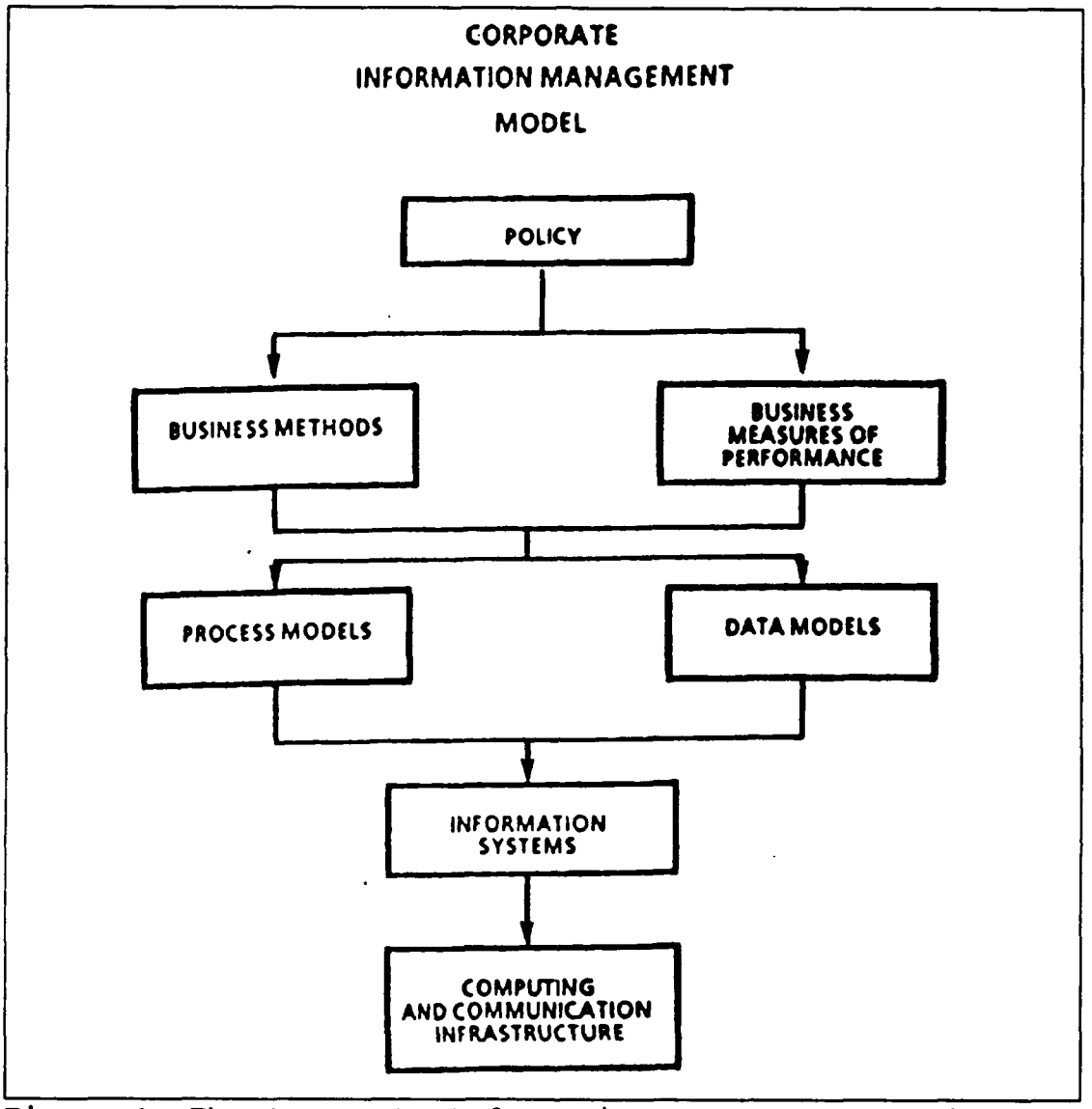

Figure 1: The Corporate Information Management Model [ELG Preface]

the CIM model. Adopting simpler methods that properly integrate IT is the end goal of the organization [Ibid].

3. Measures of Performance

Efficiency and effectiveness of operations resulting from implementing the business methods are evaluated within

the framework of the established measures. Applying these measures as a method of evaluating comparable operations will "... provide insight to the strengths and weaknesses ...". [Ibid] Appropriate measures of government operations need to be defined and "... regularly reexamined and refined." [Ibid]

4. Process Models

Graphical descriptions of tasks and their sequence are used to document business methods. These are key to improving operations by revealing "... better ways of doing business ...". [Ibid] Missions of the organization are documented in validated process models [Ibid].

5. Data Models

"Data models formally define the terms (data) used in a business method." [Ibid] The business language, comprised of these terms and relationships, is to be captured in a dictionary. [Ibid] This dictionary and the data models "... comprise a corporate information standard ..." [Ibid] that is essential to information sharing.

6. Information Systems

"Common process models and common data models are a prerequisite of common information systems." [Ibid] Common systems implement common business methods and measures of performance. [Ibid] Before new business methods are implemented, new information systems will be required [Ibid].

7. Infrastructure

This is the integrated computer and communication technology that provides the operational support for organizational users. It includes the following modules:

- Information processing centers
- Office automation
- Communication networks [Ibid]

This infrastructure provides the "... information needed to support management decisions." [Ibid]

C. MODEL EXECUTION STRATEGY

The CIM plan also specifies the way in which the CIM model is to be applied.

> Executing the Corporate Information Management model from the top down can lead to dramatic improvement in business effectiveness and efficiency of an organization whether private sector or government. Driving this model from the bottom up, ... re-automates old ways of doing business and potentially institutionalizes ineffective and inefficient ways of doing business. [Ibid]

Merging technology and business methods within the CIM model to design information systems, "... requires that users and technical support groups collaborate at every stage of execution." [Ibid]

D. DOD ENTERPRISE MODEL

The CIM implementation plan submitted by the Assistant Secretary of Defense (Command, Control, Communications and Intelligence) ($ASDC^3I$) provides the DOD Enterprise model

(Figure 2) which "... is based on a review of key DOD documents." [ASDC^{3}I Tab D p. 1] "The Enterprise model is a tool to fulfill direction provided by the Secretary of Defense and the CIM Executive Level Group...". [Ibid] This model is "... a top level summary representation of DOD functions and information ...". [Ibid] "It is the foundation for both the organization and content of detailed ... CIM functional models." [Ibid] The DOD mission, goals, vision and functions along with their relationships are represented in the model.

1. Common Functions

The DOD mission forms the core of the model, which is further defined by goals and vision [ASDC^{3}I Tab D Exhibit B]. The IRM functions of DOD organizational elements are derived from the common functions of the Enterprise model and keyed to the following DOD mission:

> The Department of Defense is responsible for providing the military forces needed to deter war and protect the security of the United States. [ASDC^{3}I Tab D Exhibit A]

Sharing resources among DOD components is motivated by the summary level and commonality of the five DOD Enterprise functions illustrated in Figure 2:

1. Set policy
2. Conduct operations
3. Provide material
4. Provide finances
5. Provide human resources [ASDC^{3}I Tab D p. 2]

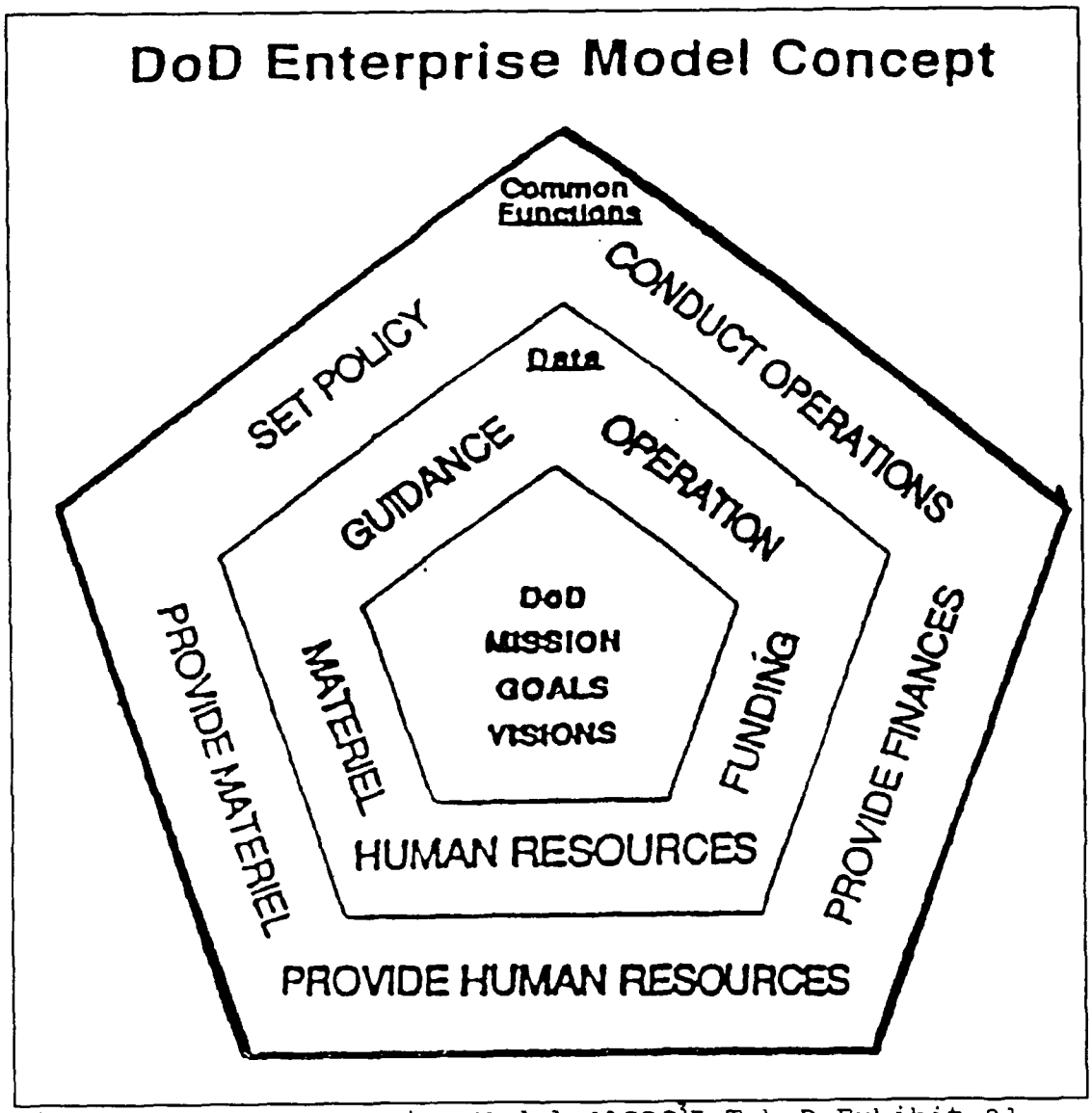

Figure 2: DOD Enterprise Model [ASDC^{3}I Tab D Exhibit 2]

Setting policy and conducting operations were not specifically included in the scope of the CIM plan [ELG p. 2]. Policy comprises the highest level of the CIM model.

2. Integration Plans

Model analysis reveals overlap of data and functions that must be integrated "... to ensure effective data sharing

across CIM Functional Groups." [ASDC^{3}I Tab D p. 2] Integration analysis is used to verify process and data consistency and that the data types meet all user requirements.

3. Business Area Analysis

The "Corporate Information Management Process Guide" describes procedures to design process and data models from business area analysis [CIM]. Focused on the information needed to support business methods and operations, the models "... become the basis for development of standard information systems in support of the DOD mission." [ASDC^{3}I Tab D, p. 2] Implementing process and data models within a structured environment "... makes it possible to align data, software, computing and communications resources to support specific organizational goals." [Ibid]

IV. AN OVERVIEW OF THE PACIFIC MISSILE RANGE FACILITY

A. ORGANIZATION

Pacific Missile Range Facility (PMRF), Kekaha, Hawaii (island of Kauai), is a directorate, Code 7000, of the Pacific Missile Test Center (PMTC) located at Point Mugu, California[1]. Naval Air Systems Command (NAVAIRSYSCOM), Washington, D. C. is the major claimant for both commands and provides its capital budget. Commander-In-Chief Pacific Fleet (CINCPACFLT) is the source of PMRF's Improvement and Modernization (I&M) and operational funding. Figure 3 provides an organizational chart for PMRF.

B. MISSION

The mission of PMRF is to provide major range, operational and base support for fleet and other Department of Defense (DOD) and government agencies as assigned by Commander PMTC. Realistic testing environments for subsurface, air and surface weapons systems are provided.

Range operations at PMRF are conducted autonomously to support elements of the Pacific Fleet, Air Force, Army, Marines, and Allies in Research, Development, Test and Evaluation (RDT&E) efforts with test range expertise developed

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[1]The material on PMRF is from Range Users Handbook, Pacific Missile Range Facility, Barking Sands, HI.

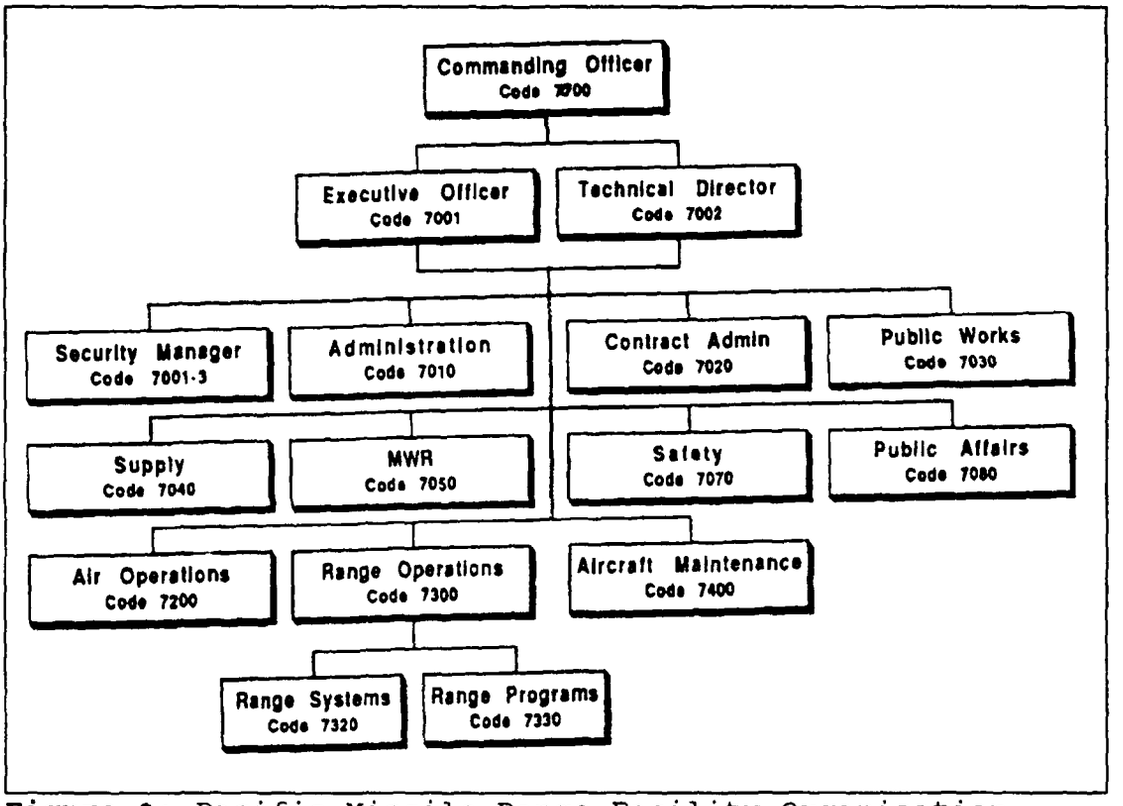

Figure 3: Pacific Missile Range Facility Organization

at PMTC. It is the largest instrumented three-environment test range in the world.

Safe, effective and efficient range instrumentation operations describe PMRF's overarching goals. Cooperation with the Range Commanders Council (RCC) ensures that range operations are conducted in accordance with national range program objectives.

Use of the electronically processed Universal Documentation Systems (UDS) provides a common format and language for stating range user's requirements in the Program Introduction (PI) document. The Statement of Capability (SC)

is used by PMRF to respond to the PI and establish the scope of the activities required to support the program.

Range support is provided on a direct cost basis. Direct costs are readily identifiable to a specific program. No direct costs for any program at PMRF will be incurred unless a funding citation or firm commitment of funds is received.

Two underwater ranges are located just off the western coast of Kauai. Barking Sands Tactical Underwater Range (BARSTUR) is a 120 square mile underwater range. Barking Sands Underwater Range Extension (BSURE) contains 880 square miles that has up to a three mile ocean depth. Figure 4 shows the relation of these ranges to Barking Sands.

C. ISLAND OF KAUAI FACILITIES

1. Barking Sands

The center for all range operations is located at Barking Sands, approximately 120 nautical miles from Pearl Harbor, Oahu. Facility Control (FACON) is located in the range operations building 105. The message center and command control consoles for all systems are located in this building. It is approximately 15 feet above mean sea level (MSL) and is the terminus for all communications links with other PMRF facilities including all underwater hydrophones.

An airfield and missile assembly area are also located at Barking Sands. An explosives storage area consisting of ten magazines is located at Kamokala Caves, two miles east of the

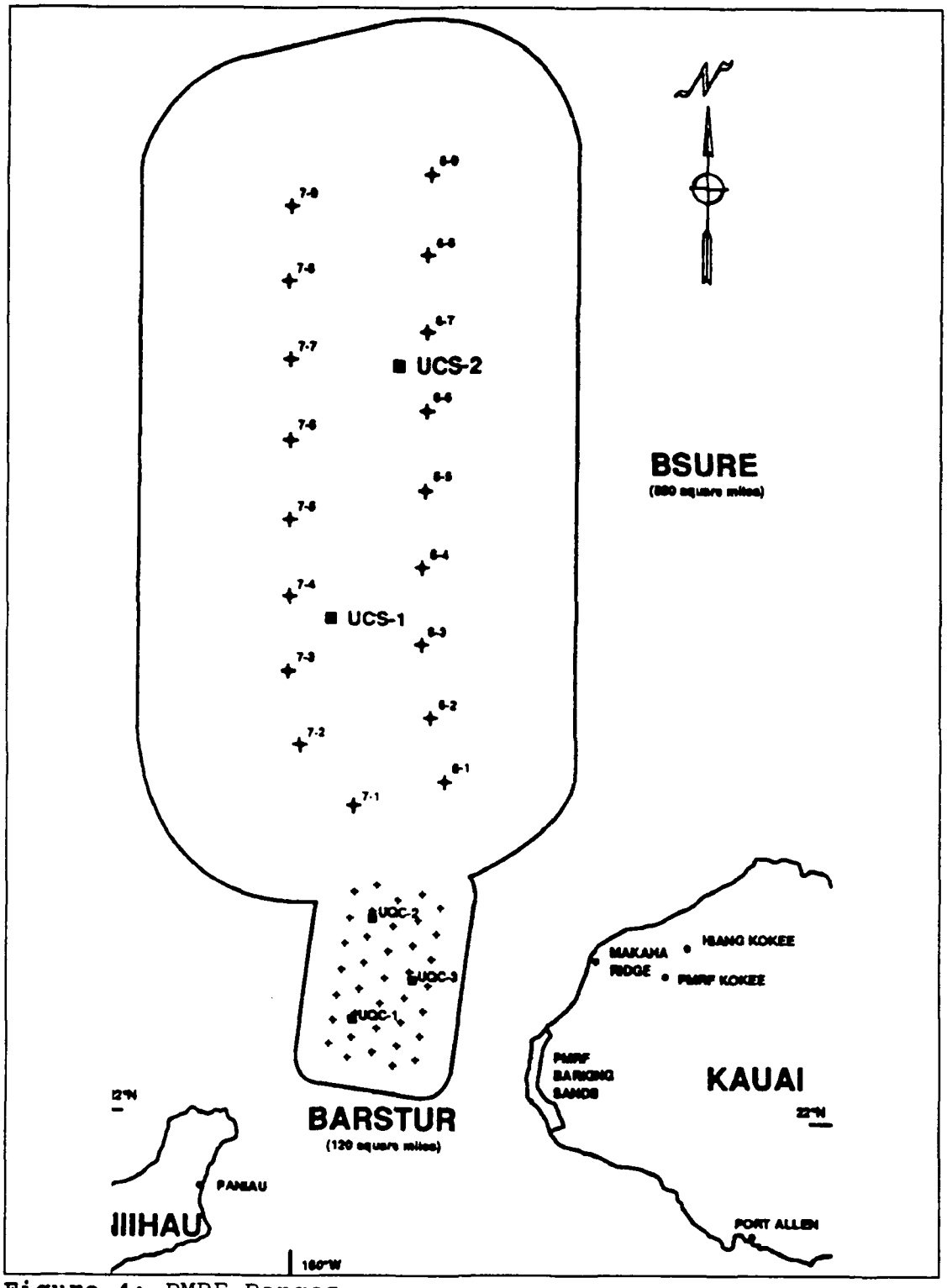

Figure 4: PMRF Ranges

base. Figure 5 shows the geographic relation between Barking Sands and other PMRF facilities.

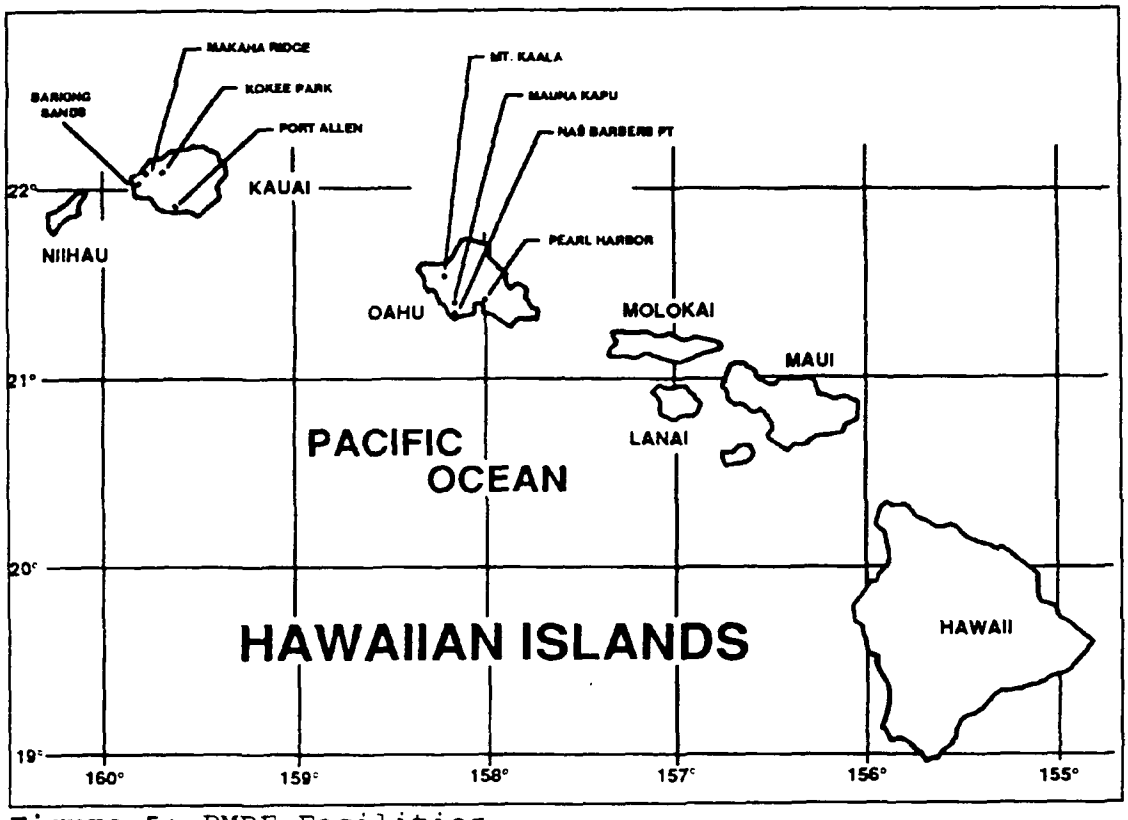

Figure 5: PMRF Facilities

a. Operational Support Functions

Range operational support functions performed at Barking Sands are:

- Range scheduling and area assignments
- Frequency assignment, monitoring and control
- Telemetry
- Radar
- Electronic warfare
- Underwater tracking and control

- Air intercept control
- Data recording and reduction
- Target launch and control
- Weapon and target recovery

These functions are performed from the Telemetry, Track and Control (TT&C) rooms in the range operations building.

b. Data Processing Systems

The real-time computer center (RTCC) in the range operations building allows operators to select, store, process and display range instrumentation data. Data sources are:

- Barking Sands Operations Support Systems (BOSS) computers
- Sensor Position and Readback System (SPARS)
- Naval Tactical Display System (NTDS)
- Automated Precision Identification Friend or Foe (IFF) Surveillance (APIS) system
- Twelve Target Tracking System (TTTS) for underwater targets
- Integrated Target Control System (ITCS)

2. Makaha Ridge

Makaha Ridge is seven miles north of Barking Sands at elevations between 1500 and 1700 feet above MSL. This is the primary telemetry station for PMRF and has four tracking and two surveillance radars. Communications facilities include sonobuoy receivers, command and control transmitters and microwave links providing connectivity to FACON. Secondary

frequency interference control (FIC) and electronic warfare (EW) assets are also located at Makaha Ridge.

3. Kokee

At an elevation of 3,832 feet above MSL, the telemetry and tracking systems at Kokee cover a larger area than the facilities at Makaha Ridge. Very high and ultra high frequency (VHF/UHF) transceivers at this site provide additional voice communications coverage. Microwave links at Kokee connect these systems and the Hawaiian National Guard (HANG) radar system to FACON.

4. Port Allen

Located 18 miles from Barking Sands, Port Allen is a seaport facility operated by the state of Hawaii. All range recovery boats and target boats are based here. Underwater targets are maintained at this facility by a detachment from the Naval Undersea Warfare Engineering Station (NUWES).

D. ISLAND OF NIIHAU FACILITIES

Located 17 nautical miles from Barking Sands, the privately owned island of Niihau has a remotely operated surveillance radar on Paniau ridge. A microwave link connects this radar to FACON.

A test vehicle recovery area is located on the uninhabited northern plains. This site is used for land recovery of test vehicles when required.

E. ISLAND OF OAHU FACILITIES

1. Pearl Harbor

A PMRF representative in Pearl Harbor coordinates equipment installations and training for ships and aircraft. Electronic warfare training services are provided from this site. Dial telephone services link personnel with FACON.

2. Mauna Kapu

Mauna Kapu is located in the Waianae mountain range at an elevation of 2,571 feet and overlooks Pearl Harbor and the Naval Air Station (NAS) at Barbers Point. High Frequency (HF) transceivers provide voice communications with FACON that connect the primary EW and FIC systems located at this site.

3. Mount Kaala

The transceiver site at Mount Kaala provides HF, VHF and UHF coverage of the Pearl Harbor area for PMRF. It is connected to FACON via a leased satellite circuit that is extended from the earth station on Oahu via a microwave link located at Makalapa to Mount Kaala.

4. Barbers Point

Building 1146 at NAS Barbers Point houses instrumentation equipment, mobile vans and aircraft pods that are put aboard range users' craft as required to carry out instrumentation activities. Coordination is maintained with FACON via dial telephone service.

V. PMRF COMMUNICATIONS PLANNING: A CASE STUDY

A. CASE STUDY

Reviewing the PACFLT Program Objectives Memorandum (POM) for the 1991 - 1994 fiscal years, Table 3, Richard Colin

TABLE 3: PMRF POM

PROJECT	$ EST (M)	POM
NTDS	12.4	91
BARSTUR	13.1	92
EW RANGE	3.3	92
EW RANGE	2.1	93
COMMUNICATIONS CENTRALIZATION	7.2	94

ran over recent events once again in his mind. Having taken over three months ago as Communications Branch head (Code 7325) in March 1990, at which time base (Admin) and range communications were consolidated, a lot of his efforts had been directed toward resolving issues concerning the digital switch installation which was the centerpiece of Communications Centralization Network (CCN) phase I.

A $10 million (M) digital switch from DataPro had been selected to extend the present telecommunication network into the new Telemetry-Track-and-Control (TT&C) rooms at the Range Operations building. Delays in this project had impacted CCN

phase II plans which were to resolve the following issues that had been presented at the PACFLT I&M conference:

- Secure range communications required by Navy directive
- Automation of user selection
- Central conference control
- Increased reliability
- Reduced maintenance cost
- Replacement of outdated analog equipment

A review of the current status and issues for the communications systems at PMRF indicated the depth and breadth to which range operations were affected by the communication centralization plans.

With the consent of the Range Systems Division head, Dick Lyke (Code 7320) and Commander Bass, Range Operations Officer (Code 7300), Richard had contracted with the O&M contractor, CommSpot, to write a report summarizing current issues and status within the Communications Branch. This report's executive summary was foremost in his mind as he considered the new communications plan.

> Prior to 1991, the Communications Branch operated with support from PMTC without any real control over how projects would be conceived or completed. The funding, labeled "PMTC Support Funds" were directly allocated to PMTC Project/Task Management who in most cases unilaterally decided what was best for PMRF. As a result, we have been left with systems reflective of poor planning, and lack of understanding of the requirements.
>
> In February 1991, these funds became more directly under the control of the Communications Branch Head, and as a result, give PMRF more control over systems development and project scope. This also gives PMRF the option of

> obtaining engineering and technical support from alternate sources. With this change in the way funds are handled, it is anticipated that closer monitoring of systems development is possible, and PMRF will be able to hold the supporting agency more accountable for delivering a better product.
>
> Additionally, manpower losses without replacement is seriously threatening the Communication Branch's ability to conduct planning and monitoring of the O&M or project contractors' performance of assigned tasking as well as monitoring individual project status. Increasing dependence on contract support is required to facilitate this Branch's ability to meet all of the various requirements.

Because of this lack of manpower, "Prioritizing my plan should help," he thought, as he put aside the report and began this important task.

Based upon data in the report, Richard had decided that Radio Frequency (RF) and microwave systems should receive first priority. These systems have the greatest impact on range operations and had been the subject of user dissatisfaction. Other users were concerned with the quality and flexibility of the video and audio systems, but many of these problems would be remedied when technical problems with the RF and microwave systems were resolved.

B. COMMUNICATIONS SYSTEMS

While reviewing the systems covered in the CommSpot report, he felt that "My focus can provide the framework for completing CCNI and planning for CCNII." The report contained background, issues, ongoing action, recommendations, lessons learned and impact for these communication systems:

- Microwave (M/W) Systems
    1. Makaha Ridge to Barking Sands M/W link
    2. Kokee to Barking Sands digital M/W link
    3. Barking Sands to Kokee Hawaii Air National Guard (HANG) analog M/W link
    4. Mount Kaala / Makalapa digital M/W link
- RF Communications
    1. High Frequency (HF) radios
    2. Very and Ultra High Frequency (VHF/UHF) radios on Makaha Ridge, Kokee Park and Barking Sands.
    3. HF/VHF/UHF radios on Oahu at Mauna Kapu
    4. Range support boat RF communications
- DataPro digital switch
- Base Telephone System
- Local Area Networks
- Message Center
- UHF Command Control and Destruct (CCD) system
- Satellite links
    1. PMRF to PMTC
    2. PMRF to Oahu

"These are just the problem systems," he sighed. Some of the equipment had been previously used at PMTC, and was turned over to PMRF as systems at PMTC were replaced. Expansion of the underwater communications systems would also be required.

Local Area Networks (LANs) and the fire and security alarm systems were high on the priority list for the base

communications system. Some of the copper cable left from 1942 when Barking Sands was first opened as Bonham Air Force Base was still in service. Many of the complaints from base telephone users could be traced to the aging, paper-wrapped cables.

While searching his files for RF systems documentation, Richard realized that very little technical documentation was available and that many of the systems lacked logistical life-cycle support. "The latest strategic Communication Plan (CommPlan) reflects this situation," he thought, "and I should budget some of the CCNII project funds for an updated management plan."

He slammed the file cabinet shut before locking up his office for the day, resolving to start work tomorrow on the plan as well as implementing the recommendations in the contractor's report. As he glanced at the microcomputer on his desk to make sure it was turned off for the night, he was reminded of the 45 minute search for on-line engineering documentation that had proved fruitless. "What has happened to the promise of the paperless office made by office automation systems?" he wondered as he surveyed the row of grey filing cabinets that lined one entire wall of the Communications Branch office.

Increasing reliance on CommSpot for planning and monitoring range projects, including the O&M contract, weighed heavily on Richard's mind on the way home through the short,

intense late afternoon Hawaiian rainstorm. "Even this lovely weather is part of my problem!" he growled to himself as he thought about the effects of rain on the RF communications systems at PMRF, especially the microwave links. The weather here would certainly influence his decision when considering fiber optic cable versus RF communications.

Perhaps an outside party could design a CommPlan that could bring the latest management methods to the remote island. "An organization unfamiliar with military and Naval communications doctrine would not suffice due to the complex environment at Barking Sands," he decided. "What is the best way to convey the problems to an outsider of managing such a variety of communications systems that must integrate widely dispersed range instrumentation systems such as the ones at Barking Sands?" he mused as he walked toward the front door of his home.

As the end of the PMRF video on range operations drew to a close, Paul Horn had made a final decision that conducting research at the Hawaiian area range would give him a way of expanding his knowledge of military communications systems and operations. As a Captain in the United States Marine Corps (USMC), he had commanded a company of Marines who had used range facilities for live- fire training, but beyond the requirement to maintain positive communications for safety, he had never considered the complexity of other systems that were required to conduct range instrumentation operations in

support of his troops. "This is the opportunity I have been waiting for," raced through his thoughts, as well as the upcoming deadline for submitting thesis topics for his Masters Degree in Telecommunications Systems Management. "After all, management is about accomplishing objectives through people, and I have that background," he concluded to himself.

Ron Ames, a Surface Warfare Officer and Lieutenant in the United States Navy, was also present that day when the PMRF Communications Branch head made his presentation at the Naval Postgraduate School in Monterey, CA. The video reminded him of one particular day when he was the Officer of the Deck (OOD) of a destroyer conducting missile exercises on the PMTC range in southern California and secure voice communications had been unreliable. "I know how he feels!" Ron thought as the video ended and Richard was describing these same symptoms. "Will Paul want to work on this research project with me?" he wondered, remembering that he and his friend had discussed the possibility of conducting a joint thesis project.

Richard and Professor Berg, the faculty advisor for the management plan project, were discussing details of the project the next day when Paul and Ron arrived to announce their decision to undertake the research. "What the Communications Branch at PMRF needs is a Strategic CommPlan" Richard explained to them. "We're here to help," responded Paul. "I feel that everyone can benefit from this work,"

Professor Berg added, confident that the task would keep them quite busy in the upcoming months. They all sat down and began planning the initial visit to PMRF, eager to get an early start.

C. BARKING SANDS, HAWAII

Reviewing their notes from interviews with numerous PMRF staff and the O&M contractor that night, Paul and Ron agreed that range communications were highly distributed in location and function for a number of reasons. "The Hazards of Electromagnetic Radiation to Ordnance (HERO) restrictions in the missile assembly and other areas certainly is one of the most important factors for the location restrictions that they must meet," Ron said as he mentally reviewed the OOD checklist for handling HERO sensitive ordnance used by his last command. "Radiation hazards to personnel must also be covered by safety regulations," he added.

During the exhausting tour of the facilities, Richard had given Ron and Paul insight into another important reason why his systems covered such a wide area. "We need to establish HF and UHF comms with the fleet as they leave Pearl Harbor on their way to the range. This link provides timely exchange of information with the participants and allows problem resolution before they actually enter the range. Communications plays a key role in conducting safe, effective and efficient range operations," Richard had told them during

the tour. Paul agreed with this view and added, "Area coverage issues must be considered to be equally important."

"These issues are important but where is the focus?" Paul wondered aloud. Ron's reaction to this question was to describe a similar shipboard environment where the nerve center for operations is the Combat Information Center (CIC) and to summarize the operational chain-of-command during range instrumentation activities. "Conduct of range operations is centrally managed from the TT&C rooms," he exclaimed to Paul. "It was just like being in the CIC of a destroyer!"

After re-examining the Range Users Handbook they were convinced that central control of all range instrumentation activity was necessary to conduct safe, effective and efficient operations. They concluded that managing the optical, infrared, RF and acoustic spectrum within the range environment is the key to providing these services, and the DataPro digital switch is the cornerstone system. "Here is a good example of where form follows function," Ron commented. "The distribution of the resources and tasks in location and function is equivalent to that of the Force Track Coordinator (FTC) for the Naval Tactical Data System program used in the fleet," he continued, now feeling closer to issues that were pertinent to both PMRF and his warfare expertise. "The DataPro switch allows FACON to manage the communications facilities from the Range Operations Center," Ron concluded.

D. POINT MUGU, CALIFORNIA

As Ron and Paul waited for Dick Lyke, who now filled the PMRF liaison billet (Code 7002-3), in his office at PMTC Point Mugu, they reviewed notes from an earlier visit. "John Knowles, from Range Communications at PMTC felt that the government policy on contracting, Office of Management and Budget Circular A-76, had driven the low bidder O&M contract at PMRF," Ron recalled, "and at PMTC most of the equivalent tasks are performed by civil service personnel." "John also felt that a lowest bid, firm fixed price contract policy can result in lower service." Paul replied and continued, "Management services are included in the contract, so Richard had to spend contract dollars to have the report written to document Communication Branch issues to use as a planning guide for technical efforts."

Paul felt that Total Quality Leadership (TQL) specifications in the contract could be implemented through a matrix management scheme. "Perhaps the cost of PMRF's O&M contract should include management services," Paul mused out loud. "These clauses might increase the cost of the contract to the point where permanent civil service jobs prove lower in cost," Ron responded. "What they need is people who are committed to the mission," he continued. "Teamwork is TQL to me, Ron," Paul replied, and reminded Ron of the 'Train your men as a team' adage from Basic School.

Dick came in and joined the two in the crowded conference room which had served him since returning to PMTC to work out details of the consolidation of RDT&E activities from NAVAIR/PMTC to CINCPACFLT due in Fiscal Year (FY) 93. He had been reviewing the provisions of the transfer in his mind on his way back to the office for the interview with the research team.

Budget bases for FY-92/93 appeared adequate to support all current projects and operations. For FY-94, after the transfer to CINCPACFLT, budget shortfalls would require that operations at PMRF in support of specific mission areas may have vertical cuts in resources.

Type Commander (TYCOM) warfare training priorities in the Pacific region were:

1. Anti-Submarine Warfare (ASW)
2. Electronic Warfare (EW)
3. Anti-Air Warfare (AAW)

Due to this policy, CINCPACFLT's budget would support all mission areas at PMRF except for AAW.

The AAW mission area at the Barking Sands range would affect national range programs including some that were under PMTC's cognizance. The long-range, high-precision tracking and surveillance radars were the systems most costly to operate and maintain. Without funding from the national programs for these systems, they would have to be inactivated

due to the AAW mission area having the lowest CINCPACFLT priority.

With the issues of the consolidation effort fresh in his mind, Dick started the interview by summarizing his thoughts to Paul and Ron. "I have concluded that systemic issues pertinent to CCNII and the CINCPACFLT claimancy consolidation will become more prevalent in the post cold-war military," Dick said. "Communications branch personnel shortfalls confirm this," and he added, "The number one problem is a decrease in manpower that has forced increased reliance on the O&M contractor for planning support." "This results in more corporate knowledge and experience resting with the contractor," he explained. "Even though we have the same people continuing in their area of expertise when the contract is renewed, the trend is to offer less pay for the same job," Dick continued. "We should have job positions that offer incentives to attract and retain the specialized skills required at PMRF in order to foster a dedicated team effort for O&M tasks," he said.

When Paul asked a question concerning information resource management processes, Dick replied, "Monthly meetings of the ADP planning board are held to address these issues. They usually end up discussing computer buys, or the meeting will end with a list of users problems."

A visit later that day to the offices of Jim Evan and Ralph Brand, who had both been involved in resolving technical

problems at PMRF, confirmed problems with the O&M contractor. Jim grumbled, "CommSpot employees had failed to carry out required periodic maintenance on a M/W link that resulted in outages. We do feel responsible when the systems that we installed fail, yet it is hard to establish a friendly rapport over there when O&M engineering support is required due to PMRF personnel shortages," he continued. "Until the contractor hours are budgeted, the project must be put on hold or PMTC personnel must work overtime to meet project deadlines," he explained.

"At PMRF, they want to go all digital with their communications, but no one there is familiar with all aspects of this project," he added. "There is equipment to digitize the radar and IFF video, yet this adds additional costs." "Each unit for one radar system costs about $110,000, but they will be able to eliminate two microwave systems with the digital equipment," Jim explained. "If they had a larger capacity digital switch or smart multiplexers, they could also eliminate the analog radar switchboard," he continued. "The digital radar converters were not available when specifications for the switch were written so the current bandwidth of the switch is not capable of handling radar switching functions."

Ralph explained other systemic problems at PMRF. "Security requirements will require more contractor involvement in training as we implement communications

security (COMSEC) and operational security (OPSEC) policies with bulk and end-to-end encryption devices," said Ralph as he focused on the security issues associated with CCNII. "Technicians at PMRF don't understand the new digital technology well enough," he continued, "and they want to connect secure and non-secure communications through the new digital switch. Current policy mandates physical and logical separation of red and black circuits," he explained, and described how this same issue had driven the decision to buy a second, separate DataPro switch for secure range communications at PMTC.

"It really concerns me that the military lacks a validated software system that is capable of ensuring separation of multiple security levels for networks," Ralph added. The requirement for complete physical separation of networks capable of specific security levels could come close to doubling the required capital investment in intercommunication systems if trusted software support was not developed for the military.

"We also discovered that the DataPro contract did not include ownership of the computer software that operates the switch," Ralph continued. "When PMRF wants to change doctrine on the way the communications links are configured, they will also have to have a new program designed for the switch. "This could cause a great time lag for the communications

configuration to catch up to the policy changes," he explained.

Bob Golf (Code 3341), one of the engineers who had installed many of the analog communications systems, agreed with Ralph. "The DataPro switch is totally different from the analog gear, physically and logically," he explained. He sighed in exasperation while reflecting on one discussion concerning the transition from analog to digital switches at PMRF, "If I could at least get them to understand that the analog comm panels require +48 volts from the line units for them to work and that the digital interface is radically different, I would feel a sense of accomplishment."

"While on the subject of analog switches, my memo of 3 July 1991 proposed detailed engineering changes to the Underwater Communication System (UCS) that must be coordinated with the switch upgrade to address expanded underwater sensor capacities," Bob added. "Extended undersea range coverage had expanded the communications requirements and this was not included in the specifications for the DataPro switch," he explained.

E. MONTEREY, CALIFORNIA

Professor Berg conferred with Ron and Paul on their latest research report. "You have fairly well established a baseline for current operations," he observed during the review. "Try and see the larger DOD picture," he advised them. "Personnel

policies that accompany consolidation and centralization are definitely at the heart of PMRF's problems," Paul commented, now remembering that these issues must be addressed when organizations and cultures change.

Ron added "Technological advances in the organization's environment can change the way people work, too, and bureaucracies are very resistant to change." "Let Ron focus on those technical issues," Paul suggested to their advisor, "and I will focus on the social and human issues that must be addressed by policy. Maybe TQL can make a difference; it certainly came to mind a number of times at PMRF where I felt that teamwork could mean the difference between success and failure on the project," Paul concluded.

Ron agreed to focus on the technical issues and reviewed some of the more pertinent ideas from his engineering classes in his mind as the meeting concluded. "Remember, the big picture is crucial," Professor Berg cautioned them as they left his office.

VI. CASE STUDY TASKS: ANALYZE CRITICAL IRM ISSUES

The purpose of this chapter is to guide the instructor or facilitator to effectively lead the class discussion to the active issues that permeate the case study. An analysis of the different perspectives of each character should provide a way for major issues and their interaction to be brought out during the case presentation.

A. CASE CHARACTERS

As each character in the case represents a different perspective on the complexity of the strategic planning process, a discussion of the view of each personality should help clarify the major points of the case study. It is important that conflicting views be identified and discussed.

1. Richard Colin

Richard Colin, the Communications Branch Head at PMRF, is the focal character of the case. Prior to the time when the case was written, the majority of the communications systems were engineered and installed by PMTC personnel. Richard now has increased responsibilities for these tasks. He must accomplish his objectives with reduced PMRF manpower and increased reliance on the O&M contractor, CommSpot.

Questions that focus student attention on this issue are:

Question: Who now provides management support for communications planning at PMRF?

Answer: CommSpot, the O&M contractor provides increased management support.

Question: Describe Richard Colin's solution to communications planning.

Answer: 1. He issues a contract to CommSpot for a technical report on communication systems. 2. He prioritizes the problems described in the report. 3. He recognizes the need for a new strategic plan. 4. He initiates a research project at the Naval Postgraduate School. This provides him with input from an outside source that is familiar with military communications.

2. Research Team

Paul Horn, a Marine Corps Captain, serves as the human resource expert for the team. He feels that Total Quality Leadership (TQL), the current military management paradigm, can provide a framework for the communications plan. Some questions to help focus on the issue of interface with the O&M contractor are:

Question: Could organizing the O&M contractors in teams with PMRF personnel correct faulty maintenance procedures?

Answer: Yes, if team leaders could be held directly responsible for performance of their team.

Question: What issues need to be addressed in the O&M contract?

Answer: Training and specific responsibilities for contractor and PMRF personnel must be made explicit in the contract.

Ron Ames is a Lieutenant in the United States Navy and a surface warfare officer. His character serves as the technical expert since he has had experience on the PMTC range

while serving as a division officer on a destroyer. Most Navy warfare specialists will have had some experience with NTDS and can easily draw the parallel between PMRF range operations and fleet operations. Some questions that bring out this point are:

Question: Should PMRF's range operations parallel fleet operational methods?

Answer: Yes, to train as you fight is the goal of military training.

Question: What NTDS function best describes Range Control functions?

Answer: The Force Track Coordinator functions are centralized in range support provided by Range Control.

Professor Berg focuses the research team on broader DOD issues. When conducting long-range planning, the environment must be considered for plans to be effective. One question that will require students to consider this issue is:

Question: What DOD programs will influence the CommPlan for PMRF?

Answer: Programs in the DOD that are pertinent to the plan are TQL, CIM, consolidation and force downsizing.

3. Dick Lyke

Formerly Range Systems Division head and Richard Colin's supervisor, Dick Lyke is now the PMRF Liaison at PMTC. He provides first-hand knowledge of how personnel shortfalls and increased reliance on the O&M contractor have affected the Communications Branch. He also brings out consolidation

issues and how they directly affect PMRF range operations. Some questions that focus on these issues are:

Question: What problems does increased reliance on contractor personnel create at PMRF?

Answer: More corporate knowledge and experience in the contractor workforce can result in less control over range operations by PMRF personnel. Lowest bid contract awards provide no incentive to maintain a highly qualified workforce for PMRF.

Question: How is operations and maintenance (O&M) at PMTC different from PMRF?

Answer: At PMTC the majority of the O&M tasks are performed by government employees. These services are provided through a low bid, firm fixed price contract at PMRF.

Question: How does PACFLT policy affect range operations at PMRF?

Answer: The priority of warfare missions could result in loss of funding for AAW support systems.

4. Point Mugu Personnel

Since PMRF systems engineering had been provided from PMTC in Point Mugu, interviews with managers and personnel there provided insight into and clarification of the situation at PMRF. Information collected here validates the system design concept of including data outside of the immediate environment when considering change.

John Knowles of PMTC Range Communications felt that Circular A-76 of the Office of Management and Budget (OMB) was the reason that O&M at PMRF is a contract service [Kaness]. He also felt that due to the lowest bid, firm fixed price nature of the contract, services of the contractor would not

compare in quality to that of government employees performing the same tasks.

An actual problem with contractor performance was described by Jim Evan by relating a specific instance where failure of CommSpot personnel to perform preventive maintenance resulted in an outage on one of the microwave links [Eden]. He also explained how the difference in work forces created friction when the PMTC engineers were working on systems at PMRF.

The character of Ralph Brand, the digital switch engineer, is given the task of explaining the requirements for separation of secure and non-secure circuits. He describes technical differences between the digital and analog equipment that is not yet understood by the PMRF O&M technicians. Training for CommSpot personnel is another problem that was mentioned in his interview [Bauman]. Lack of ownership of the DataPro switch software is mentioned as a potential future problem. This character is also given the task of discussing the relation of multiple level security (MLS) software to secure communications.

Bob Golf, who installed the analog switching equipment at PMRF, confirms the lack of digital switch knowledge there. He also provided a memo that points out a lack of capacity in the underwater communications system (UCS) that was not addressed in the contractor's status report [Grove].

Questions to aid in focusing on the issues in the case that are raised by PMTC personnel are:

Question: What government policy led to the O&M contract at PMRF?

Answer: Circular A-76 from OMB was the driving force behind contract services for O&M at PMRF.

Question: Were CommSpot personnel fulfilling all contract obligations at PMRF?

Answer: No, some communications outages were due to the lack of preventive maintenance.

Question: Were PMRF personnel properly trained on the digital switch?

Answer: No, they wanted to use some of the analog equipment with the new switch.

Question: How will the lack of MLS software for the DataPro switch affect communications at PMRF?

Answer: The lack of MLS will require additional capital investment in another switch to meet security requirements.

B. CENTRALIZATION ISSUES

Information systems can exhibit highly distributed or highly centralized architectures. Some key concepts that must be considered when making centralization decisions are:

1. Degree of distribution
2. Organizational issues
3. Distribution options
4. Decision factors
5. A balanced perspective [Leigh and Burgess p. 26]

PMRF's centralization plan must include elements from each of these concepts.

1. Degree of Distribution

Three characteristics of the system elements that reflect the degree of distribution are:

1. Location
2. Function
3. Control [Leigh and Burgess p. 26]

Question: Characterize the communications systems at PMRF with respect to location, function and control.

Answer: The current communications architecture at PMRF is highly distributed with respect to location and function. User control is highly centralized at the Range Operations Center during range operations.

2. Organizational Issues

In many cases, the structure of the organization dictates the function and pattern of the IS architecture. Factors that can influence system design are:

1. Autonomy of the communications function
2. Organizational goals
3. Political issues [Leigh and Burgess p. 30]

When developing centralization plans at PMRF, all of these factors must be considered.

(1) Autonomy

The communications planning environment is influenced by internal and external forces. Understanding these influences is crucial to developing a strategic plan.

Question: Describe the planning environment that Richard Colin must consider while developing the CommPlan.

Answer: Communications planning at PMRF was influenced to a great degree by planners at PMTC. System engineering for PMRF communications is now more directly under the control of the PMRF Communications Branch Head. Contracts for Operation and Maintenance (O&M) at PMRF are mandated firm fixed price contracts. The planner for PMRF communications has less autonomy since he must rely upon contractor services for planning support due to manpower shortfalls.

(2) Organizational Goals

Organizational goals for PMRF are quite clear and specific. Communications systems play a major role in meeting these goals, especially in range safety.

Question: How do the communications systems at PMRF help fulfill their mission?

Answer: Microwave radios carry Identification Friend or Foe (IFF) data as well as tracking and telemetry needed to conduct successful range operations. Voice communications play a vital role in executing safe and successful range operations.

(3) Political Issues

The O&M contract mentioned earlier is the major political consideration for Richard Colin when developing the CommPlan. At PMTC, internally controlled government employees conduct O&M, but at PMRF these functions are performed by contractors. Conditions of the O&M contract do not provide the incentive for quality service and freedom of interaction between the planners and workers.

C. CENTRALIZATION OPTIONS

Mission requirements are the driving force for PMRF communications facilities. Guiding case discussion in this direction could be accomplished with questions like these:

Question: What mission requirements at PMRF are the basis for such widely dispersed communications facilities?

Answer: 1. The requirement to establish communications with fleet units as they exit Pearl Harbor enroute to the PMRF range is one reason for physical distribution. 2. Radiation hazards and interference of powerful RF equipment prohibits location near the missile assembly building or areas where people must be present during operations. 3. Area coverage requirements for radar and communications systems used to conduct range operations mandates distributed facilities.

Question: What system allows central control over the dispersed communications equipment?

Answer: The DataPro switch does provide the capability to establish central control of the widely separated facilities.

D. DECISION FACTORS

Business justification for IT must drive the strategic plan for the Communications Branch. Factors that should be considered include:

1. Economic factors
2. Information requirements
3. Organizational and political factors [Leigh and Burgess p. 47]

In light of reductions in military budgets due to force downsizing, the most important factors will be economic.

1. Economic Factors

Defense Management Review Directive 924 proposes a pay-for-service policy for information resources. Return on investment will be the key decision factor for a make or buy decision. The DOD unit costing initiative uses a full cost model for planning and considers all costs to be variable in the long run [Faulk p. 60]. Strategic planning is an appropriate place for unit costing to be used.

Federal Information Processing Standard (FIPS) 146 mandates Government Open System Interconnection Profiles (GOSIP) for future systems. This publication provides standards that commercial manufacturers must meet before selling equipment to government users. This is the key strategy towards increasing market competition for DOD purchases, and reducing equipment costs. Commercial off the shelf (COTS) acquisition policies for communications equipment will help reduce costs by providing a larger market base from which to choose.

2. Information Requirements

Identifying users of the data that is collected on the PMRF range and their needs will drive the instrumentation activities. This is an example of how external data requirements influence IS design at PMRF.

Data required to conduct safe range operations at PMRF is an example of internal information requirements. A well

designed IS will support these internal and external requirements. Risk exposure analysis will reveal information that is required to meet mission objectives. This management decision tool is useful for hazard and policy analysis and program evaluation [Davis p. 115].

Security issues are applicable to external and internal information requirements. Due to the wide spectrum of data that is required to accomplish PMRF objectives, multiple level network security issues must be addressed when defining these requirements.

3. Organizational and Political Factors

Corporate culture is manifested in a sense of business direction that revolves around the mission [Leigh and Burgess p. 52]. Organizational experience and goals influence communications planning by providing the environment in which plans are formulated. Decisions that must meet multiple, political objectives can be made in a group decision support environment by allowing the combination of synergy and knowledge from the people responsible for the outcomes of the decision [Davis p. 62].

E. A BALANCED PERSPECTIVE

An effective plan will balance all of the factors mentioned above into a decision that will serve organizational goals best. Since benefits of centralization can be hard to quantify, organizational and political perceptions can

outweigh tangible costs [Leigh and Burgess pp. 54-55]. These perceptions can be summarized in two principles:

1. Information models the organization.
2. Organization structure should be mirrored by IS. [Leigh and Burgess p. 57.]

Military organizations in general, and PMRF specifically, prefer centralized control for communications services. The proposed communications plan that follows will be based on these two principles.

VII. CASE STUDY TASKS: DEVELOP THE PROPOSED PLAN

A. THE CIM PROCESS

As the current DOD methodology for IRM, CIM is used as the framework for designing the management plan proposal for the Communications Branch. The CIM Process Guide [CIM], phase I is the model for the CommPlan. As an integrated part of this plan, mission, scope, guiding principles and visions for IRM at PMRF and the Range Operations Department will be proposed first and are based on material from the Range Users Handbook [PMRF-91B].

The proposed plans for PMRF and the Operations Department equate to the metamodeling or strategic level and modeling or operational level, respectively, and are less concise than a fully developed plan for the Communications Branch. Specific proposals in these plans are used to reflect higher level commitment to design decisions that affect planning efforts at lower levels.

The CIM Process Guide breaks down the CIM methodology into three phases:

- Phase I: Functional vision
- Phase II: Functional business plan
- Phase III: Information systems strategy [CIM]

This plan will contain phase I proposals only, and will consider communications as another CIM functional group. Should these proposals be accepted, they will become the basis for functional business plans at PMRF.

B. PACIFIC MISSILE RANGE FACILITY

1. Mission

The mission of the Pacific Missile Range Facility is to conduct range operations in support of international, national and Department of Defense programs as assigned by the Commander-in-Chief Pacific Fleet. These missions will all be derived from National Security Strategy.

2. Scope

Sea, air and land instrumentation operations are conducted in support of assigned missions. Managing this activity will require support from all levels of the organization.

3. Guiding Principles

The team concept is the framework for integrating decentralized facilities that provide range services that are centrally controlled. These teams will be organized like combat systems teams that have proven successful in the fleet.

Corporate Information Management describes the design of process and data models that form the foundation for the information systems that support the conduct of information warfare. All business methods and measures of performance

must conform to policy and be documented within the Information Resource Dictionary System. This dictionary is the source of the common business language for the Department of Defense.

4. Vision of the future

Range training is tailored to user requirements by process and data models for all warfare areas. These models are derived from National Security Strategy. This ensures managers that their business methods have been reviewed and validated at the highest levels of our government.

Generic warfare scenarios are available to authorized subscribers over the Defense Information System Network (DISN) and are readily adaptable to all military missions. The scenarios are designed to support the principle of "train as you fight".

Operations on and in support of the range reflect a commitment to training warfighting specialists in assigned mission areas using state of the art command and control systems and tactics. Business operations mirror this methodology and allow managers to apply these same techniques to their area of responsibility and benefit from increased effectiveness.

Teamwork is the key to our success. Our human resource policies and programs have developed a dedicated team of warfighting specialists that help shape policy at higher

levels through cooperation with international, national and military councils. Their knowledge base has been captured in validated process and data models that provide the basis for a world-wide group decision support system that allows multimedia conferences which share information and expertise.

5. Objective

In support of the mission, the primary objective of PMRF is to plan, organize and control safe, effective and efficient range operations. This service is tailored by the use of process and data models to user requirements.

6. Programs

The future of operations at PMRF will require the input of all stakeholders. Programs that will set the course for PMRF are:

1. An information resource management council (IRMC) proposes data and process models for the production of instrumentation information from range operations.

2. The PMRF human relations management council (HRMC) proposes policy for all employees.

3. A financial management council (FMC) reviews the risk exposure analysis from all departments and submits a proposed budget that minimizes all risks of conducting operations.

C. OPERATIONS DEPARTMENT

1. Mission

The mission of the PMRF Operations Department is to conduct range instrumentation operations in support of

assigned missions. Range operational doctrine will reflect polices from a wide variety of sources.

2. Scope

Range instrumentation objectives are met by monitoring and surveying the optical, infrared, radio frequency and acoustic spectrums for sea, air and land activity. All participants within the range environment will be controlled from the Range Operations Center during scheduled operations. Non-participants must be warned before they interfere with operations or become endangered by these activities. Close liaison with pertinent military and civil authorities is essential to ensure non-interference with range operations by non-participants. Dissemination of area closure notices and other restrictions on the use of the spectrum in the vicinity of the range will promulgated.

3. Guiding Principles

Operations at the range are indistinguishable to the user from current warfare tactics. Warfare team training is conducted by professionals who employ information warfare methods in their day-to-day business activities.

Open systems architectures are required to seamlessly integrate internal and external user requirements for information. This benefits everyone by providing technical standards that can be met by private industry and allow their purchase in an open, competitive marketplace.

A common Information Resource Dictionary System (IRDS) defines the business language for all warfare areas and provides the cornerstone of a distributed, multimedia decision support system. This system provides synchronous and asynchronous access to the corporate knowledge base that allows team leaders to make safe, effective decisions in an efficient manner.

4. Vision of the Future

The Copernicus architecture is now implemented throughout the Department of the Navy (DON) as the common information warfare system. Built upon process and data models that are derived from National Defense Strategy, it provides effective and efficient business methods that are used for both warfighting and business operations.

As an integrated part of range operations, training for operators of the Commander-in-Chief Complex (CCC) and Tactical Command Center (TCC) is conducted at the Range Operations Center. Building upon the extensive knowledge base of range operations at PMRF, our information production center is recognized as a definitive source for warfare doctrine.

Sensor and communications coverage of the surrounding area has been vastly increased and improved by developing and employing an unmanned, tethered aerostat from Kokee Park at altitudes of up to 10,000 feet. This system has eliminated the need for some of the dispersed facilities, thereby

reducing costs and increasing the effectiveness of range instrumentation systems.

Scalable, massively parallel computer systems fulfill all processing requirements at PMRF. Operating systems that POSIX compliant harness this power effectively and efficiently.

D. COMMUNICATIONS BRANCH

The content of the following proposed master plan for the Communications Branch at PMRF is modeled after the "Planning Structure and Content" section of the CIM plan [ELG preface]. Appropriate sections of the CIM plan were adapted to the function of providing communications services.

1. Mission

The mission of the PMRF Communications Branch is to provide communications services in support of PMRF's mission. These services are tailored to user requirements.

2. Scope

Optical, infrared, radio frequency and acoustic spectrum management is executed by the Communications Branch in support of range operations. Communications systems that cover the sea, air and land environments are the key to conducting safe, effective and efficient operations.

3. Guiding Principles

The guiding principles for the PMRF Communications Branch are adapted from the "Guiding Principles" section of the CIM plan [ELG p. 3].

1. The frequency spectrum will be managed through centralized control and decentralized execution.

2. Simplification by elimination and integration is to be preferred to automation whether developing new or enhancing existing communication systems.

3. Proposed and existing business methods will be subject to cost-benefit analysis which includes benchmarking against the best public and private sector performance.

4. New business methods will be proven or validated before implementation.

5. Communications systems performing the same function must be common unless specific analysis determines they should be unique.

6. The Communications Branch Head will be held accountable for all benefits and all directly controllable costs of developing and operating the communications systems.

7. Communications systems will be developed and enhanced according to a DOD-wide methodology and accomplished in a compressed time-frame in order to minimize the cost of development and achieve early realization of benefits.

8. Communications systems will be developed and enhanced in the context of process models that document business methods.

9. The communications infrastructure will be transparent to the information production systems that rely upon it.

10. Common definitions and standards for data will be used from the DOD Information Resource Dictionary System (IRDS).

11. Communications services will be acquired through competitive bidding considering internal and external sources.

12. Data will be entered only once.

13. Access to information will be facilitated, and/or controlled and limited as required. Information will also be safeguarded against unintentional or unauthorized alteration, destruction or disclosure.

14. The user interface to communications systems shall be friendly, consistent and easily adapted to all missions.

4. Future Vision

Fiber optic cable provides connectivity among all fixed, land-based range facilities with sufficient bandwidth to support the most demanding data requirements. A Broadband Integrated Services Digital Network (BISDN) network provides the backbone for our X.400 based multimedia systems and connects our facilities with the DISN.

This network supports the Copernicus Global Information Exchange System (GLOBIXS). It connects our Range Operations Center with the CCC at Pearl Harbor, allowing real-time data from range operations to be monitored at the CCC.

The Blacker encryption system fulfills all network multiple level security (MLS) requirements among our fixed facilities. This allows our multimedia group decision support system to be used as the single method of managing the communications spectrum.

The unmanned tethered aerostat at Kokee is connected to the Range Operations Center via the secure X.400 multimedia network. Successful deployment of optical, infrared, RF and acoustic communications systems on this platform have allowed the closure of the facilities at Mauna Kapu, Mount Paniau and

portions of the leased satellite circuits, improving service and reducing costs.

5. Situation Analysis

An exhaustive situation analysis is contained in the "PMRF Communications Branch Status and Issues" document prepared in July 1991 [PMRF-91A]. Interviews with PMTC engineers revealed the need to include the UCS in the plan [Grove]. This system should be connected to the digital switch to allow ubiquitous interfaces with the communication system.

Another issue that must be addressed is that of converting raw radar video to a 1.544 million bits per second (MB/S) digital stream to allow encryption so that COMMSEC and OPSEC security requirements can be met [Eden]. If the capacity of the digital switch is large enough to handle these links, then the analog radar video switch could be removed. Smart multiplexers could also perform the switching function. Additional costs to fit each radar display console with a digital to analog converter would also be required.

6. Objective

All information resource decisions must be made with PMRF's mission as the primary deciding factor. Providing tailored range services for our customers is the primary objective. In support of this objective, the Communications

Branch will provide safe, effective and efficient communications services.

7. Goals

To achieve the vision of the Communications Branch, specific goals for the management of human resources, plant equipment, materiel and information must be achieved. Goals toward accomplishing this vision are:

1. Implement a training plan for CIM, unit costing and risk exposure analysis by the end of FY 93.

2. Complete installation of the secure network by the end of FY 94.

3. The multimedia group decision support system will have a prototype implementation by the end of FY 94.

4. A research and development study for the aerostat concept will be completed in FY 95.

8. Strategy

Strategies for the communications plan proposal are adapted from the CIM strategies [ELG p. 22].

1. Develop process models that document existing and new communications business methods in conjunction with Copernicus GLOBIXS efforts.

2. Develop data models for communications business methods that are consistent with the DOD IRDS.

3. Develop and implement a set of cost effective, common communications systems based logically upon data and process models and based physically upon CIM technical standards.

4. Manage expenditures for communications using the unit costing methodology.

5. Institute a life-cycle management methodology that addresses process and data models and educate Communications Branch personnel on its use.

6. Establish measures for the value added to range operations through spectrum management. Risk exposure analysis is used to show the full value of communications systems.

7. Educate Branch personnel in the CIM concepts and provide a formal way to evaluate their feedback on the CIM process.

9. Program Plans

Active participation of Communications Branch personnel in PMRF programs is essential to achieving the proposed objectives. Issues and proposals are reviewed and submitted to the councils through the group decision support system.

10. Organization Structure

The organization of the Communications Branch is reflected in the data and process models that document the business methods in use at PMRF. This allows a logical way to assign responsibilities for managing the labor, plant equipment and materiel essential to accomplishing our mission. These models are used to develop and manage the Operations and Maintenance contract.

11. Resources

Information is our most important resource. The IRDS contains the business language that is the cornerstone of our knowledge-based, multimedia group decision support system. A highly skilled and motivated workforce uses this system to

manage all communications systems in a safe, effective and efficient manner. Corporate knowledge is archived in the system, lessening the impact of personnel attrition and turnover.

12. Implementation Issues

Changes occurring inside and outside of the organization are reviewed by all stakeholders and proposed revisions are submitted to the appropriate council through the decision support system. These proposals are reviewed by the council and submitted to the Commanding Officer for approval.

Technical standards issued by the Defense Information Systems Agency ensure that all communications systems are acquired within DOD guidelines. Adhering to these standards will ensure seamless integration of range and user systems. Using Federal Information Processing Standards (FIPS) a common user interface for all systems reduces personnel training time and increases their effectiveness and efficiency.

Life-cycle management of all systems is automated by the Engineering Data Management Information Control System (EDMICS). This system provides on-line configuration management, import and export of drawings and technical data, and data archiving.

The data and process models are the basis for generating customized software for the digital switch and decision support system. Computer Aided Software Engineering

(CASE) tools provide an automated way of initializing these models by reverse engineering current databases including the EDMICS database. With the addition of generic interface modules, the computer code can be rapidly prototyped and tested prior to loading into the computer.

Determination of required network and switch capacities can also be based on analysis of the data and process models. Validated models will also provide the means for implementing logical and physical security requirements. A multiple level security (MLS) software system will allow logical extension of secure voice requirement to distributed locations through a single switching facility.

VIII. CONCLUSIONS AND ISSUES

A. CASE STUDY RESULTS

Education for future military decision makers must include the opportunity for these managers to develop skills in designing information systems that mirror organizations and their missions. The case study of the Pacific Missile Range Facility (PMRF) at Barking Sands provides an excellent opportunity for military IRM students to analyze communications centralization issues in a post cold war environment and exercise skills in writing action plans for a military organization. The proposed plan provided as part of the study is a basis for classroom discussion of alternative ways of designing strategic plans and resolving IRM issues.

B. PROPOSED COMMUNICATION PLAN

Corporate Information Management (CIM), as the standing metamodel for IRM in the DOD, provides the framework for analysis and recommended solutions to the issues of centralization faced by the Communications Branch Head at PMRF. Phase I proposals required by the CIM process were developed using the system design approach.

The proposed CommPlan is intended to be used as a strategic planning document for PMRF. Certain conclusions are

implicit within the proposed plan. A discussion of these areas provides motivation for the concepts.

1. Range Operations Concept

Overarching the proposed communications plan is the strategy of military training that advocates the "train as you fight" concept. According to the Director of Defense Information, "System designs must be based on command, control, communications, computer and intelligence requirements." [Green] This principle is the motivation for adoption of the Copernicus architecture as the way to integrate training with range operations at PMRF.

2. The Decision Environment

Advocating a group decision support environment for range operations provides a structured way of making multiple criteria decisions and eliciting feedback from all users. A system of this type will also allow managers to make effective decisions more efficiently by avoiding the "phone tag" syndrome. Use of a single means of making both operational and business decisions reinforces managerial skills. Organizational cultures will adapt to the changing decision environment when successful outcomes are realized from this powerful tool.

User satisfaction with policy decisions that affect their work will increase when their feedback is used by the organization that is responsible for planning, organizing and

controlling the policy. This can create added value for stakeholders when the policies are politically accepted at all levels of implementation.

3. Multiple Level Security

Only a full risk exposure analysis can determine whether or not MLS software can allow all levels of classified and unclassified data to be controlled through a common digital switching system. Logical security controls extended over a network with MLS software, along with proper physical separation measures and encryption embedded as required in interface hardware, can significantly reduce the OPSEC and COMMSEC risks of central network control through a centrally located switch.

Requirements of all DOD security directives must be fully met or waivers requested using risk analysis as justification. Costs of security measures must include the risks of unauthorized disclosure for all data elements and processes along with the requisite hardware costs. Every additional process layer adds corresponding costs and benefits. The additional network overhead for security, as well as all layered services, motivates parallel processor architectures that exploit concurrent execution for increased information production capabilities.

4. Technical Standards

The most valuable technical guidance for implementation issues in the proposed communication plan is the open-systems reference model mandated by the Defense Information Systems Agency [Brewin-92]. This model provides a set of technical standards that will allow interoperability among DOD information systems. Network security and management services technical standards are scheduled to be available in a final form on October 1, 1992 [Ibid].

5. Software Development From Process and Data Models

Information engineering methods implemented in Computer Aided Software Engineering (CASE) tools holds great promise in reverse engineering current databases and computer code which will assist in developing and maintaining models for current systems [Luke]. Models for communications services required for range operations can be used in a CASE environment to develop and maintain the digital switch software.

Taking advantage of physical design attributes that are captured in the Engineering Data Management Information and Control System (EDMICS) database, CASE tools can reverse engineer configuration data into entity relationship diagrams. This system is under review for acquisition by PMTC to automate design configuration management [Peterson].

6. Extending Communications and Sensor Coverage

The unmanned aerostat proposed for PMRF is one possible way that area coverage requirements could be met without operating widely dispersed, fixed facilities. Coast Guard aerostats have already been used in cost-effective surveillance of Caribbean choke points [Anderson].

Due to a recent Congressional decision, the Army has taken over the Mobile Aerostat Program from the Coast Guard. Three of the balloons have been deactivated and the support ships idled [Ibid]. The fate of this program remains unresolved. This provides a unique opportunity for PMRF to leverage Coast Guard and Army efforts in this area and develop this system as a resource for instrumentation operations on the Barking Sands range.

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